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Forest Pest Management
2810 Chiles Rd., Ste. B
Davis, CA 95616

Drop Size Spectra For Beecomist, Micronair, And 8006 Flat Fan Nozzle With Dipel 8L And Thuricide 48LV

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Drop Size Spectra For Beecomist, Micronair, And An 8006 Flat Fan Nozzle With Dipel 8L And Thuricide 48LV

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This publication reports research involving pesticides or their simulants. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

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PREFACE

The purpose of this wind tunnel test was to establish drop size characteristics of *Bacillus thuringiensis* atomized with a Micronair, Beecomist, and flat fan nozzle. These tests were run specifically in support of USDA Forest Service (FS) field operations which were conducted in 1985. This report represents formalization of data which was provided to field units in 1985. Wind tunnel data are used by the FS in selecting proper equipment for pesticide application. Data are used also as input to mathematical models which predict spray coverage, canopy penetration, and off-target drift.

Funding was provided by USDA Forest Service, Forest Pest Management, Washington Office. Questions and comments should be directed to John W. Barry, USDA Forest Service, Forest Pest Management, 2810 Chiles Road, Suite B, Davis, CA 95616 (916)758-4600.

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Introduction:

Tests were conducted in a wind tunnel to measure drop size spectra from two different rotary atomizers and from a 8006 flat fan nozzle oriented 90° to the airstream using Dipel 8L and Thuricide 48LV at different flow rates and air speeds.

Equipment:

A Beecomist 360A spinner operated at 28VDC, a Micronair AU5000 spinner with standard 3.63 inch blades and a Spraying Systems 8006 flat fan nozzle were used for all tests.

The tests were conducted in a wind tunnel with a test section 8 ft. long and 2 x 2 ft. cross section. A Particle Measurement System (PMS) probe, OAP-2D-GAl, with a PMS 11-C data acquisition system was used to measure the drop size spectra. The probe has a nominal class size of 33 μm. The system counts and classifies the drops into 62 size classes from 28 to 2062 μm.

Procedures:

The 8006 flat fan nozzle was oriented at 90° to the airstream and mounted on a microprocessor controlled mechanism that could move the nozzle to scan the entire spray pattern. The Beecomist spinner was operated at 28VDC and maintained an rpm of 12,700 for all tests. The Micronair blade angle was adjusted for all tests to maintain 7600 rpm. The rotary atomizers were positioned vertically at 9 positions. For the Beecomist, this represented 8 equal sampling ring areas of 70.8 in^2 plus a center area of 5.9 in^2. For the Micronair, this represented eight rings of 37.7 in^2 plus a center area of 12.6

in^2. A spinner test consisted of measuring the drop spectra in each of the 9 sampling areas then combining these into one composite pattern that represents the overall temporal drop size distribution for the atomizer. All tests were repeated and the results averaged to determine the drop size distribution for each test condition.

Table I shows the tank mixtures for the selected application rates for each atomizer. Table II shows the flow rate per atomizer required for selected air speed, swath width, number of units and application rate for each atomizer. Table III shows the flow regulator and pressure used to achieve the desired flow rate.

Results:

Table IV is a summary of the drop size spectra for the selected formulations, airspeed, and flow rates for each atomizer. The nomenclature used is as follows:

$D_{V.1}$ = Diameter that contains 10% of volume in drops of smaller size.

$D_{V.5}$ = Diameter that contains 50% of volume in drops of smaller size. (Volume median diameter)

$D_{V.9}$ = Diameter that contains 90% of volume in drops of smaller size.

$$\text{Relative Span} = \text{R.S.} = \frac{D_{V.9} - D_{V.1}}{D_{V.5}}$$

The data shows that the drop size is almost the same for the Beecomist tests run at 50 mph and the Micronair tests run at 135 mph at the two concentrations of Dipel 8L. This indicates that the droplet breakup is primarily due to the high rpm of the spinners and was not affected very much by the air speed or the concentration of the Dipel 8L. The two tests run with the Thuricide 48LV indicates that this material generates a smaller particle size than the Dipel 8L for similar test conditions. The appendix contains the

complete drop size frequency data, statistical results and graphs for all the tests.

Summary:

Two different rotary atomizers and an 8006 flat fan nozzle were evaluated. The rpm of the rotary atomizers were kept constant for all tests and gave similar results using the Dipel 8L formulations. The tests using the Thuricide 48LV produced a smaller drop size than the tests using the Dipel 8L. The 8006 flat fan nozzles directed at 90° to the airstream produced the largest drop size for all the tests.

Table I

Tank Mixture and Total Application Rates

Atomizer	Formulation	Conc. of form. BIU/Gal	Conc. of form. BIU/Ac	Tank mix Pt form:Pt water	Total application rate oz tank mix/acre
8006 flat fan	Dipel 8L	64	12	Undiluted	24
8006 flat fan	Dipel 8L	64	12	1:1	48
Beecomist	Dipel 8L	64	12	Undiluted	24
Beecomist	Dipel 8L	64	12	1:1	48
Beecomist	Dipel 8L	64	16	1:1	64
Beecomist	Thuricide 48LV	48	12	Undiluted	32
Beecomist	Thuricide 48LV	48	12	1:1	64
Micronair	Dipel 8L	64	12	Undiluted	24
Micronair	Dipel 8L	64	12	1:1	48
Micronair	Dipel 8L	64	16	1:1	64

Table II

Flow Rate Required For Selected Applications

Atomizer	Air-speed mph	Swath Width ft.	Total Applic. Rate oz/acre	Total flow rate gpm	No. of Atomizers	Flow rate per atomizer gpm
8006 flat fan	135	150	24	7.7	13	0.6
8006 flat fan	135	150	48	15.3	26	0.6
Beecomist	50	50	24	1.48	4	0.37
Beecomist	50	50	48	2.8	4	0.7
Beecomist	50	50	64	3.8	4	0.95
Beecomist	50	75	32	1.88	4	0.47
Beecomist	50	75	64	3.8	4	0.95
Micronair	135	150	24	7.6	8	0.95
Micronair	135	150	48	15.2	8	1.9
Micronair	135	150	64	20.5	8	2.56

Table III

Adjustments Required for Selected Flow Rates and Formulations

Atomizer	Flow Rate gpm	Formulation	Spraying Systems Flow Regulator	Pressure psi
8006 flat fan	0.6	Dipel 8L	--	40
8006 flat fan	0.6	50% Dipel 8L	--	40
Beecomist	0.37	Dipel 8L	#59	30
Beecomist	0.47	Thuricide 48LV	#68	30
Beecomist	0.7	50% Dipel 8L	#68	60
Beecomist	0.95	50% Thuricide 48LV	VRU #7	25
Beecomist	0.95	50% Dipel 8L	VRU #7	25
Micronair	0.95	Dipel 8L	#86	40
Micronair	1.9	50% Dipel 8L	#120	45
Micronair	2.56	50% Dipel 8L	#140	40

Table IV

Summary of Drop Size Spectrum From the Atomizers With Selected Mixtures

Atomizer	Angle /rpm	Air-speed mph	Flow Rate gpm	Mixture	Drop size, µm $D_{V.1}$	$D_{V.5}$	$D_{V.9}$	R.S.
8006 flat fan	90°	135	0.6	Dipel 8L	118	212	322	0.96
8006 flat fan	90°	135	0.6	50% Dipel 8L	101	187	289	1.01
Beecomist	12,700	50	0.37	Dipel 8L	<56	122	184	1.07
Beecomist	12,700	50	0.7	50% Dipel 8L	58	124	184	1.07
Beecomist	12,700	50	0.95	50% Dipel 8L	62	128	195	1.04
Beecomist	12,700	50	0.47	Thuricide 48LV	<56	89	161	1.42
Beecomist	12,700	50	0.95	50% Thuricide 48LV	<56	104	169	1.16
Micronair	7,600	135	0.95	Dipel 8L	67	124	173	0.85
Micronair	7,600	135	1.9	50% Dipel 8L	68	128	180	0.88
Micronair	7,600	135	2.6	50% Dipel 8L	60	120	175	0.95

Table V - Drop Size Data, 8006 Flat Fan Nozzle, 135 mph, .6 gpm, Dipel 8L Neat

Nozzle	8006 FLAT FAN	Slice Rate	4 MHz
Angle to Airstream	90 degrees	AVG	100
Spray Pressure	40 psi	DFM	1 cm.
Airspeed	135 mph	BAR	1.5
Flow Rate	.6 gpm	Distance to Probe	51 cm.
Tank Mix	DIPEL 8L,NEAT	Sample Interval	360 sec.
		Number of Samples	1
		Number of Scans	10
FILE: C:\PMS\DATA\10078509.001		Scan Spacing	2.5 cm.
Number of Tests Combined: 2		Scan Length	38 cm.

UPPER LIMIT	N(RAW)	N/SEC	Gm/SEC	% N	% VOL.	ACCUMULATED % N	ACCUMULATED % VOL.
56	3055	1.47E+07	0.48	47.37	1.40	47.37	1.40
89	5419	4.78E+06	0.95	15.35	2.75	62.72	4.16
122	4081	3.77E+06	2.29	12.12	6.63	74.84	10.79
154	3496	3.03E+06	4.15	9.75	12.03	84.59	22.81
187	2564	1.93E+06	4.99	6.20	14.46	90.79	37.27
220	1960	1.34E+06	5.85	4.30	16.95	95.08	54.21
252	1442	760971	5.18	2.45	15.02	97.53	69.23
284	986	415939	4.18	1.34	12.10	98.86	81.33
318	544	193022	2.78	0.62	8.04	99.48	89.37
351	297	110990	2.17	0.36	6.29	99.84	95.66
382	107	28821	0.74	0.09	2.13	99.93	97.79
414	48	14665	0.48	0.05	1.40	99.98	99.19
447	13	4594	0.19	0.01	0.55	100.00	99.74
479	4	538	0.03	0.00	0.08	100.00	99.82
512	0	0	0.00	0.00	0.00	100.00	99.82
545	0	0	0.00	0.00	0.00	100.00	99.82
578	2	659	0.06	0.00	0.18	100.00	100.00
TOTAL	2.40E+04	3.11E+07	34.53				

TOTAL ACCEPTED RAW PARTICLES / TOTAL IMAGES = 24018/ 29713 = 80.8%

NUMBER MEAN DIA.= D_{10}.... 88.42 µm
VOLUME MEAN DIA.= D_{30}.... 128.49 µm
SAUTER MEAN DIA.= D_{32}.... 179.36 µm

NUMBER MEDIAN DIA.= $D_{N.1}$... <56 µm
$D_{N.5}$... 61.93 µm
$D_{N.9}$... 183.12 µm

VOLUME MEDIAN DIA.= $D_{V.1}$... 118.02 µm
$D_{V.5}$... 211.69 µm
$D_{V.9}$... 321.60 µm

RELATIVE SPAN= 0.96

Figure I

Nozzle Type . . . 8006 FLAT FAN
Angle to Airstream 90°
Spray Pressure . . 40 psi
Airspeed . . . . . 135 mph
Flow Rate . . . . .6 gpm
Tank Mix: DIPEL 8L, NEAT

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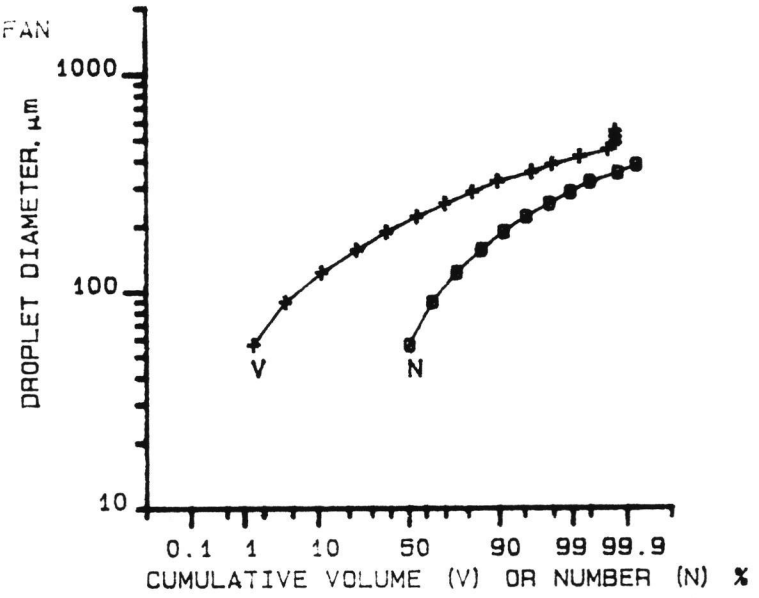

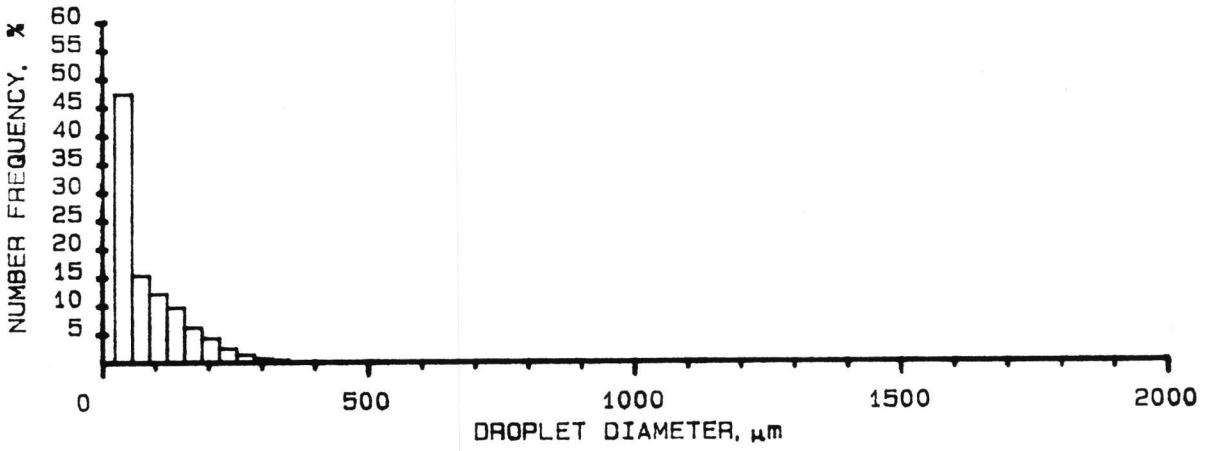

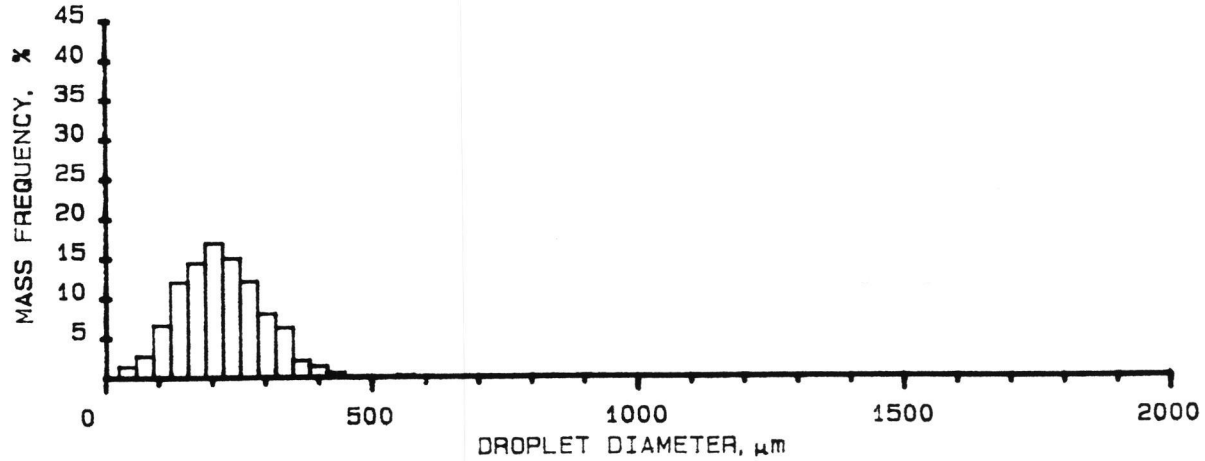

Table VI - Drop Size Data, 8006 Flat Fan Nozzle, 135 mph, .6 gpm, 1 Part Dipel 8L, 1 Part Water

Nozzle	8006 FLAT FAN	Slice Rate	4 MHz
Angle to Airstream	90 degrees	AVG	100
Spray Pressure	40 psi	DFM	1 cm.
Airspeed	135 mph	BAR	1.5
Flow Rate	.6 gpm	Distance to Probe	51 cm.
Tank Mix	50% DIPEL 8L,50% WATER	Sample Interval	360 sec.
		Number of Samples	1
		Number of Scans	10
FILE: C:\PMS\DATA\10078514.002		Scan Spacing	2.5 cm.
Number of Tests Combined: 2		Scan Length	38 cm.

UPPER LIMIT	N(RAW)	N/SEC	Gm/SEC	% N	% VOL.	ACCUMULATED % N	ACCUMULATED % VOL.
56	4315	2.31E+07	0.76	50.83	2.17	50.83	2.17
89	6376	7.63E+06	1.52	16.79	4.33	67.62	6.50
122	4657	5.64E+06	3.43	12.41	9.77	80.03	16.27
154	4088	4.11E+06	5.62	9.03	16.02	89.07	32.29
187	3158	2.45E+06	6.35	5.40	18.11	94.46	50.40
220	2204	1.29E+06	5.64	2.83	16.07	97.30	66.48
252	1410	689459	4.70	1.52	13.40	98.81	79.88
284	765	325916	3.27	0.72	9.34	99.53	89.21
318	355	135833	1.95	0.30	5.57	99.83	94.78
351	118	45400	0.89	0.10	2.53	99.93	97.31
382	64	23038	0.59	0.05	1.68	99.98	98.99
414	14	4029	0.13	0.01	0.38	99.99	99.37
447	6	1352	0.06	0.00	0.16	99.99	99.53
479	4	3181	0.16	0.01	0.47	100.00	100.00
TOTAL	2.75E+04	4.55E+07	35.07				

TOTAL ACCEPTED RAW PARTICLES / TOTAL IMAGES = 27534/ 36021 = 76.4%

NUMBER MEAN DIA.= D_{10}.... 79.81 µm
VOLUME MEAN DIA.= D_{30}.... 113.83 µm
SAUTER MEAN DIA.= D_{32}.... 157.79 µm

NUMBER MEDIAN DIA.= $D_{N.1}$... <56 µm
$D_{N.5}$... <56 µm
$D_{N.9}$... 160.01 µm

VOLUME MEDIAN DIA.= $D_{V.1}$... 100.77 µm
$D_{V.5}$... 186.56 µm
$D_{V.9}$... 288.97 µm

RELATIVE SPAN= 1.01

Figure II

Nozzle Type . . . 8006 FLAT FAN
Angle to Airstream 90°
Spray Pressure . . 40 psi
Airspeed . . . . . 135 mph
Flow Rate . . . . .6 gpm
Tank Mix: 50% DIPEL 8L, 50% WATER
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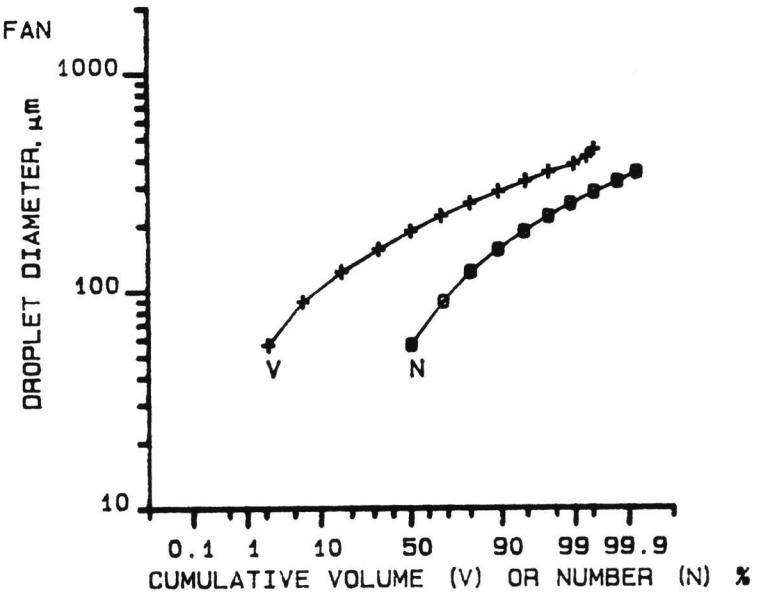

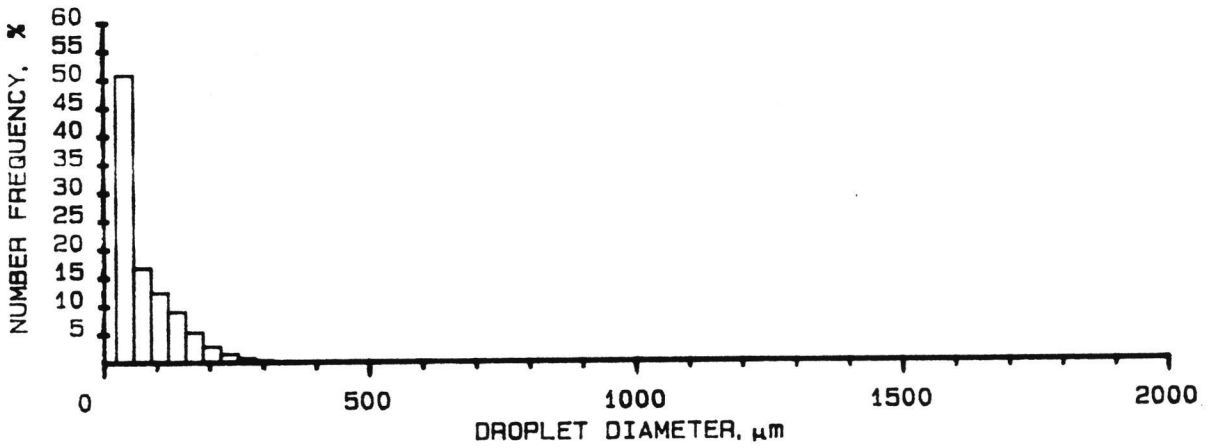

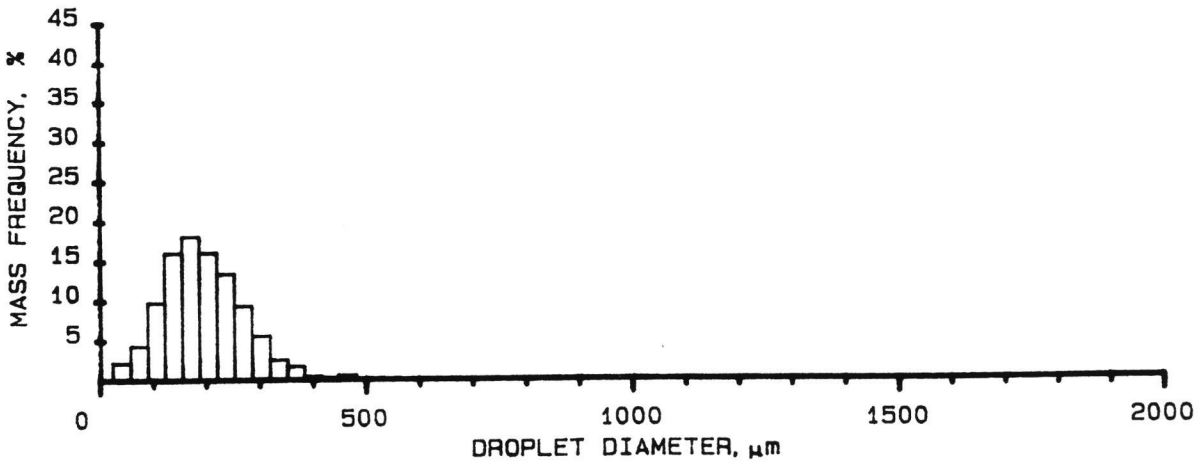

Table VII - Drop Size Data, Beecomist 360A, 50 mph, .37 gpm, Dipel 8L Neat

Nozzle	BEECOMIST 360A	Slice Rate	1.5 MHz
RPM	12700	AVG	20000
Spray Pressure	30 psi	DFM	1 cm.
Airspeed	50 mph	BAR	1.5
Flow Rate	.37 gpm	Distance to Probe	25 cm.
Tank Mix	DIPEL 8L,NEAT	Sample Interval	60 sec.
		Number of Samples	1
FILE: C:\PMS\DATA\11048512.003		Number of Sample Rings	8

Number of Tests Combined:2

UPPER LIMIT	N(RAW)	N/SEC	Gm/SEC	% N	% VOL.	ACCUMULATED % N	ACCUMULATED % VOL.
56	13209	7.96E+07	2.62	69.99	11.59	69.99	11.59
89	15030	2.05E+07	4.08	18.06	18.07	88.05	29.66
122	13445	7.47E+06	4.53	6.57	20.08	94.61	49.75
154	17618	4.38E+06	5.99	3.85	26.53	98.46	76.27
187	11614	1.35E+06	3.48	1.18	15.42	99.65	91.69
220	5199	352026	1.54	0.31	6.82	99.96	98.51
252	822	45495	0.31	0.04	1.37	100.00	99.89
284	42	2244	0.02	0.00	0.10	100.00	99.98
318	2	178	0.00	0.00	0.01	100.00	100.00
351	1	44	0.00	0.00	0.00	100.00	100.00
TOTAL	7.70E+04	1.14E+08	22.58				

TOTAL ACCEPTED RAW PARTICLES / TOTAL IMAGES = 76982/ 95234 = 80.8%

NUMBER MEAN DIA.= D_{10}.... 55.87 µm
VOLUME MEAN DIA.= D_{30}.... 72.42 µm
SAUTER MEAN DIA.= D_{32}.... 94.80 µm

NUMBER MEDIAN DIA.= $D_{N.1}$... <56 µm
$D_{N.5}$... <56 µm
$D_{N.9}$... 98.76 µm

VOLUME MEDIAN DIA.= $D_{V.1}$... <56 µm
$D_{V.5}$... 121.92 µm
$D_{V.9}$... 183.68 µm

RELATIVE SPAN= 1.07 Extrapolated

Figure III

Nozzle Type . . . BEECOMIST 360A
RPM 12700
Spray Pressure . . 30 psi
Airspeed . . . . . 50 mph
Flow Rate . . . . .37 gpm
Tank Mix: DIPEL 8L, NEAT

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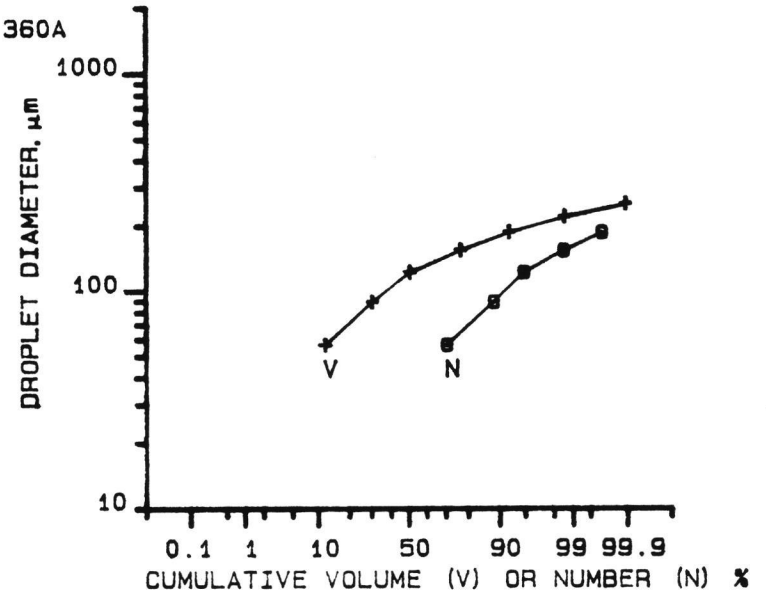
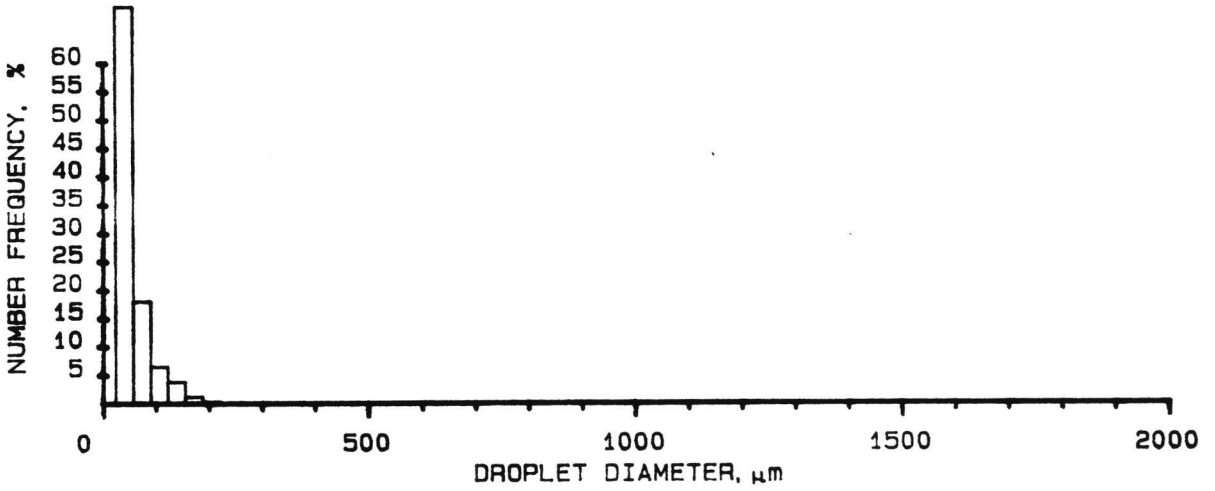




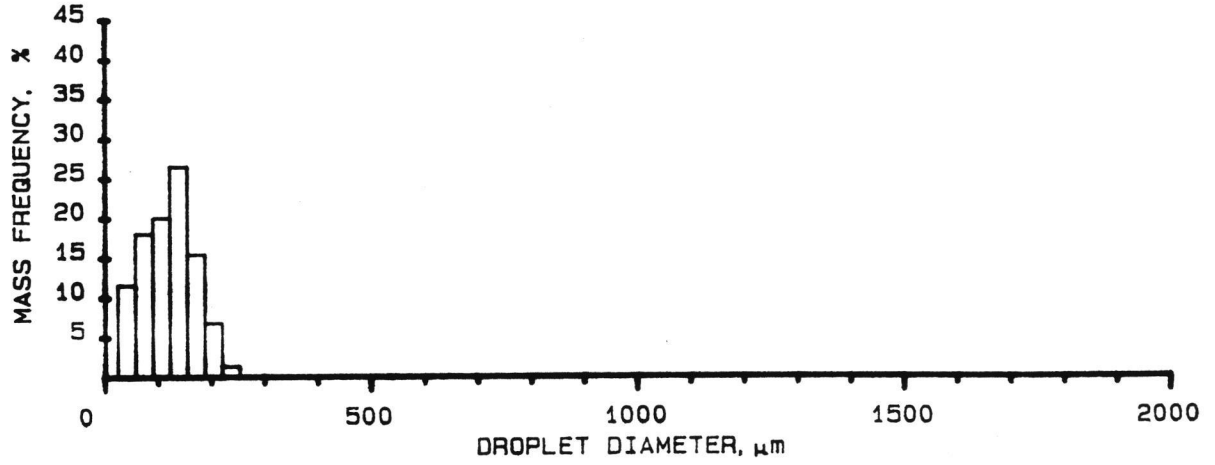


Table VIII - Drop Size Data, Beecomist 360A, 50 mph, .7 gpm, 1 Part Dipel 8L, 1 Part Water

Nozzle	BEECOMIST 360A	Slice Rate	1.5 MHz
RPM	12700	AVG	20000
Spray Pressure	60 psi	DFM	1 cm.
Airspeed	50 mph	BAR	1.5
Flow Rate	.7 gpm	Distance to Probe	25 cm.
Tank Mix	50% DIPEL 8L,50% WATER	Sample Interval	60 sec.
		Number of Samples	1
FILE: C:\PMS\DATA\11048514.003		Number of Sample Rings	9

Number of Tests Combined:2

UPPER LIMIT	N(RAW)	N/SEC	Gm/SEC	% N	% VOL.	ACCUMULATED % N	ACCUMULATED % VOL.
56	17170	1.21E+08	3.99	66.59	9.10	66.59	9.10
89	17914	3.03E+07	6.03	16.63	13.74	83.22	22.84
122	20068	1.84E+07	11.19	10.12	25.52	93.34	48.36
154	15551	8.51E+06	11.65	4.67	26.56	98.01	74.92
187	10384	2.82E+06	7.29	1.55	16.63	99.55	91.55
220	3400	762508	3.34	0.42	7.61	99.97	99.15
252	187	45540	0.31	0.02	0.71	100.00	99.86
284	12	4224	0.04	0.00	0.10	100.00	99.96
318	3	1307	0.02	0.00	0.04	100.00	100.00
TOTAL	8.47E+04	1.82E+08	43.86				

TOTAL ACCEPTED RAW PARTICLES / TOTAL IMAGES = 84689/ 107183 = 79.0%

NUMBER MEAN DIA.= D_{10}.... 59.15 µm
VOLUME MEAN DIA.= D_{30}.... 77.20 µm
SAUTER MEAN DIA.= D_{32}.... 100.74 µm

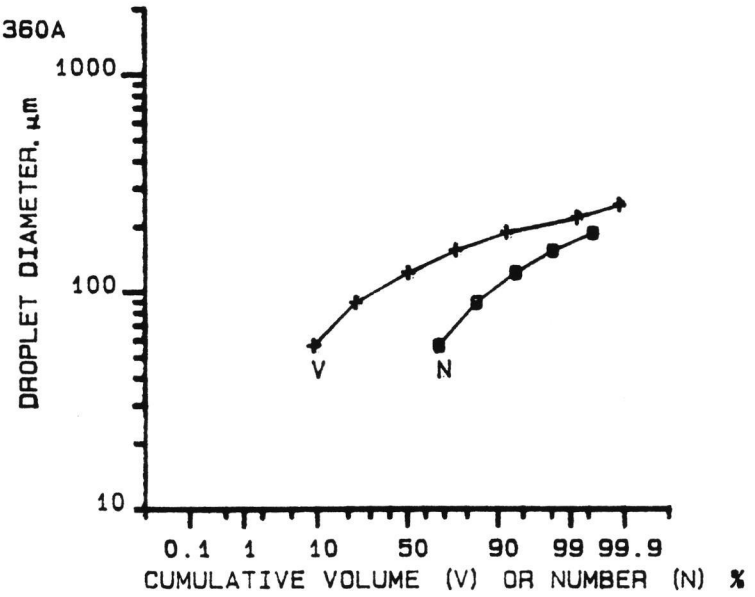
NUMBER MEDIAN DIA.= $D_{N.1}$... <56 µm
$D_{N.5}$... <56 µm
$D_{N.9}$... 111.05 µm

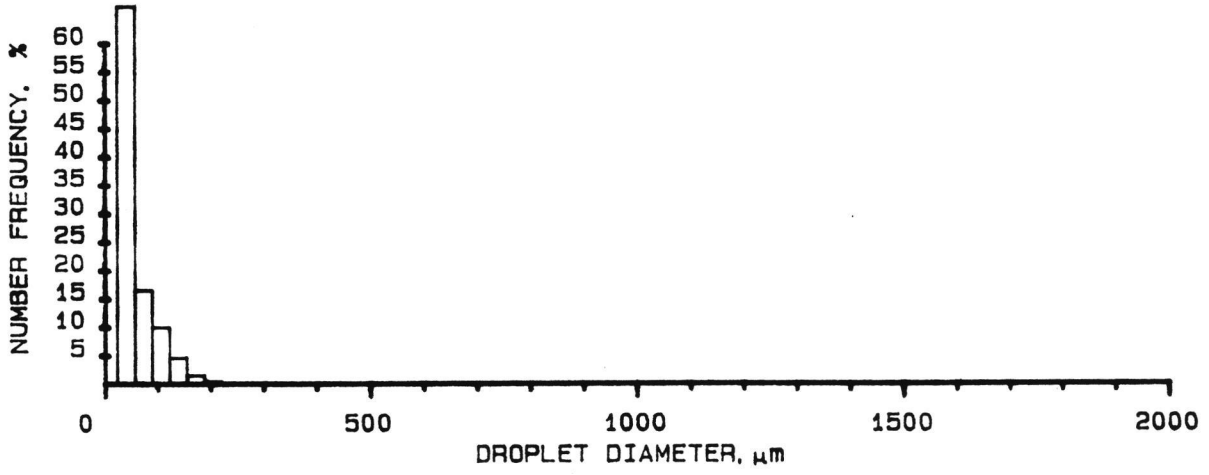
VOLUME MEDIAN DIA.= $D_{V.1}$... 58.43 µm
$D_{V.5}$... 123.64 µm
$D_{V.9}$... 184.23 µm

RELATIVE SPAN= 1.02

Figure IV

Nozzle Type . . . BEECOMIST 360A
RPM 12700
Spray Pressure . . 60 psi
Airspeed . . . . . 50 mph
Flow Rate . . . . .7 gpm
Tank Mix: 50% DIPEL 8L, 50% WATER
FILE: C: \PMS\DATA\11048514.003





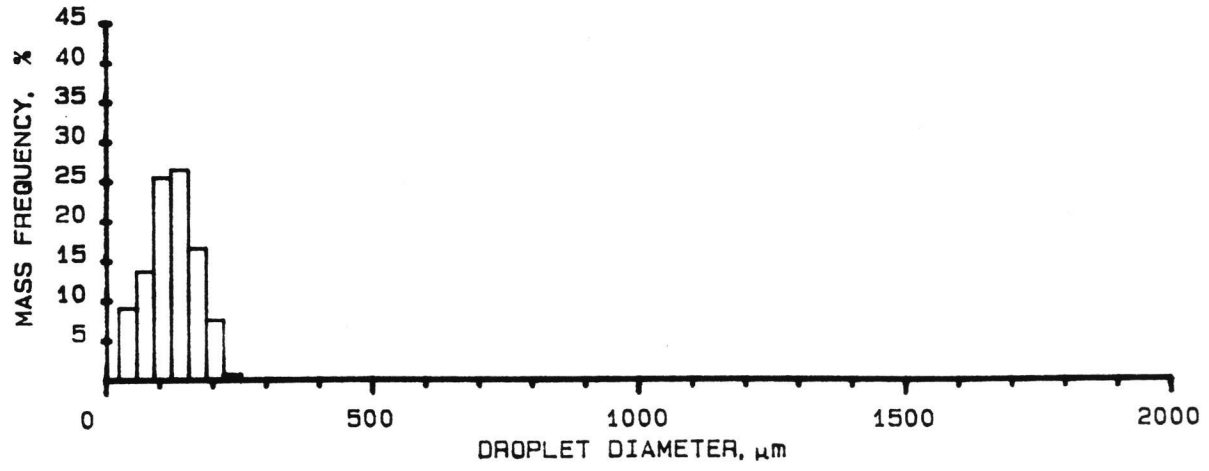


Table IX - Drop Size Data, Beecomist 360A, 50 mph, .95 gpm, 1 Part Dipel 8L, 1 Part Water

Nozzle	BEECOMIST 360A	Slice Rate	1.5 MHz
RPM	12700	AVG	20000
Spray Pressure	25 psi	DFM	1 cm.
Airspeed	50 mph	BAR	1.5
Flow Rate	.95 gpm	Distance to Probe	25 cm.
Tank Mix	50% DIPEL 8L;50% WATER	Sample Interval	60 sec.
		Number of Samples	1
FILE: C:\PMS\DATA\11078513.003		Number of Sample Rings	9

Number of Tests Combined:2

UPPER LIMIT	N(RAW)	N/SEC	Gm/SEC	% N	% VOL.	ACCUMULATED % N	ACCUMULATED % VOL.
56	17386	1.34E+08	4.40	64.40	7.81	64.40	7.81
89	18014	3.53E+07	7.01	16.97	12.43	81.37	20.24
122	19124	2.32E+07	14.10	11.18	25.00	92.55	45.24
154	13586	1.02E+07	13.90	4.89	24.65	97.43	69.89
187	10380	3.88E+06	10.03	1.87	17.80	99.30	87.69
220	5328	1.24E+06	5.41	0.60	9.59	99.90	97.28
252	970	199403	1.36	0.10	2.41	99.99	99.69
284	62	12495	0.13	0.01	0.22	100.00	99.91
318	4	1127	0.02	0.00	0.03	100.00	99.94
351	4	1658	0.03	0.00	0.06	100.00	100.00
TOTAL	8.49E+04	2.08E+08	56.37				

TOTAL ACCEPTED RAW PARTICLES / TOTAL IMAGES = 84858/ 110041 = 77.1%

NUMBER MEAN DIA.= D_{10}.... 61.02 µm
VOLUME MEAN DIA.= D_{30}.... 80.36 µm
SAUTER MEAN DIA.= D_{32}.... 105.52 µm

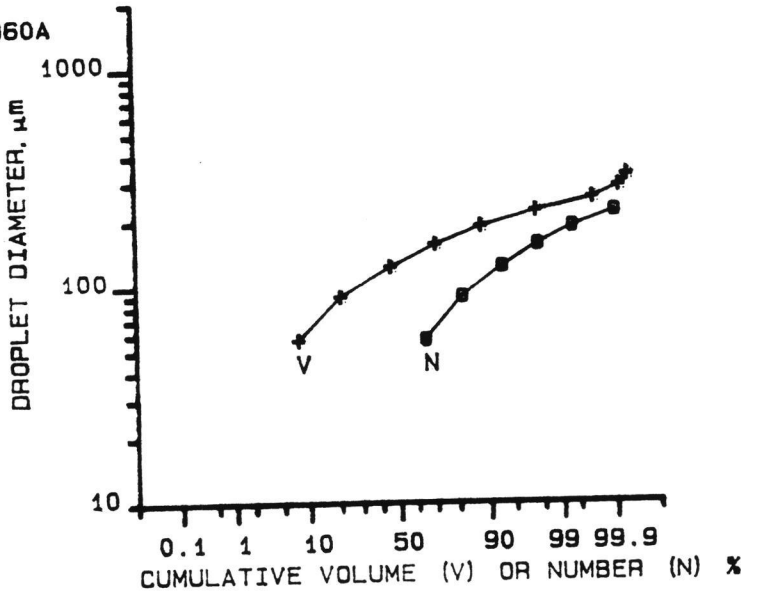
NUMBER MEDIAN DIA.= $D_{N.1}$... <56 µm
$D_{N.5}$... <56 µm
$D_{N.9}$... 114.42 µm

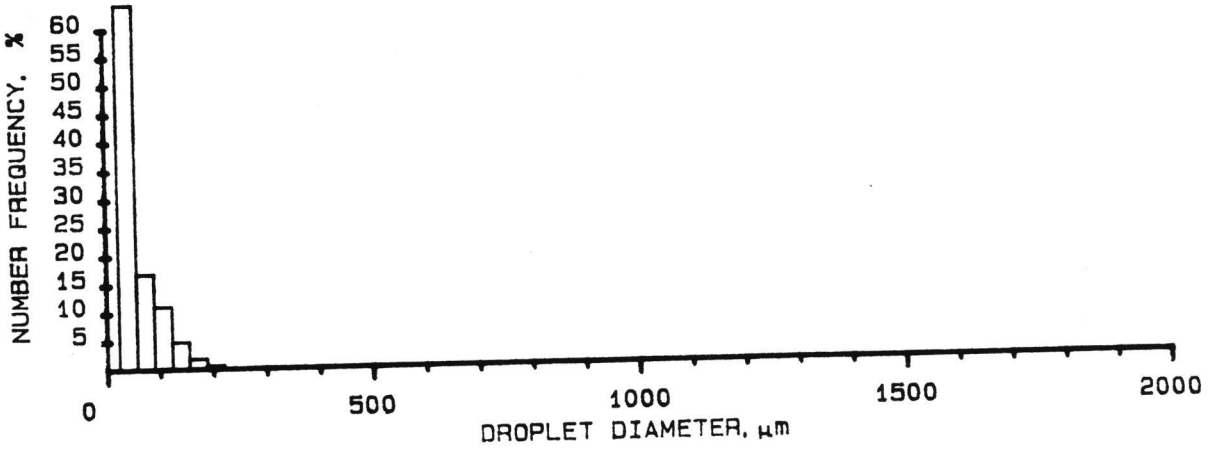
VOLUME MEDIAN DIA.= $D_{V.1}$... 62.10 µm
$D_{V.5}$... 127.97 µm
$D_{V.9}$... 194.85 µm

RELATIVE SPAN= 1.04

Figure V

Nozzle Type . . . BEECOMIST 360A
RPM 12700
Spray Pressure . . 25 psi
Airspeed . . . . . 50 mph
Flow Rate . . . . . .95 gpm
Tank Mix: 50% DIPEL 8L, 50% WATER
FILE: C:\PMS\DATA\11078513.003





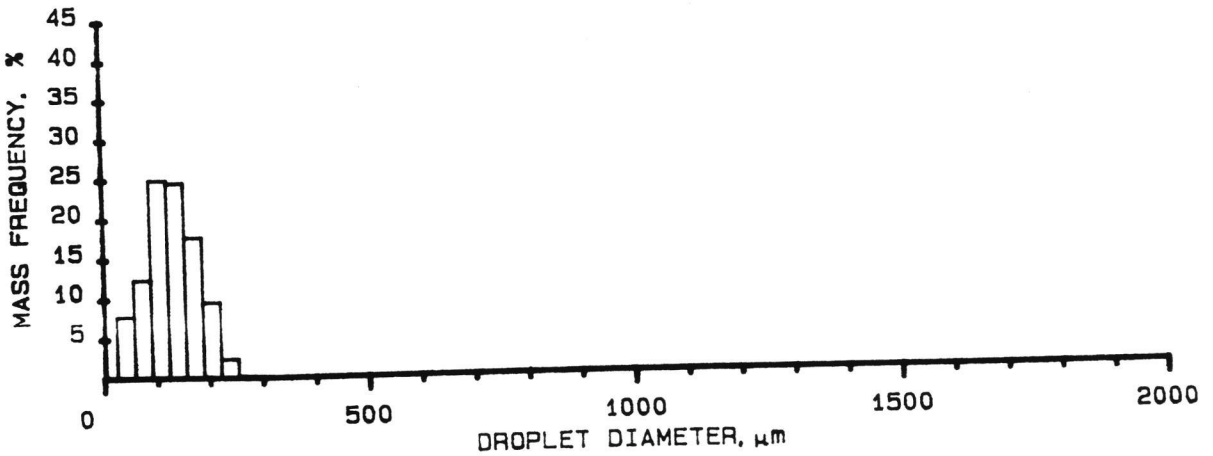


Table X - Drop Size Data, Beecomist 360A, 50 mph, .47 gpm, Thuricide 48LV Neat

Nozzle	BEECOMIST 360A	Slice Rate	1.5 MHz
RPM	12700	AVG	20000
Spray Pressure	30 psi	DFM	1 cm.
Airspeed	50 mph	BAR	1.5
Flow Rate	.47 gpm	Distance to Probe	25 cm.
Tank Mix	THURICIDE 48LV,NEAT	Sample Interval	60 sec.
		Number of Samples	1
FILE: C:\PMS\DATA\08288511.003		Number of Sample Rings	9

Number of Tests Combined:2

UPPER LIMIT	N(RAW)	N/SEC	Gm/SEC	% N	% VOL.	ACCUMULATED % N	ACCUMULATED % VOL.
56	20839	1.98E+08	6.50	82.14	26.09	82.14	26.09
89	21130	3.05E+07	6.06	12.66	24.30	94.81	50.39
122	18098	8.23E+06	5.00	3.42	20.05	98.23	70.44
154	13659	3.26E+06	4.46	1.36	17.91	99.58	88.35
187	6060	841250	2.18	0.35	8.74	99.93	97.09
220	1584	150823	0.66	0.06	2.65	100.00	99.74
252	90	8250	0.06	0.00	0.23	100.00	99.96
284	6	932	0.01	0.00	0.04	100.00	100.00
TOTAL	8.15E+04	2.41E+08	24.92				

TOTAL ACCEPTED RAW PARTICLES / TOTAL IMAGES = 81466/ 103182 = 79.0%

NUMBER MEAN DIA.= D_{10}.... 48.04 µm
VOLUME MEAN DIA.= D_{30}.... 58.29 µm
SAUTER MEAN DIA.= D_{32}.... 72.59 µm

NUMBER MEDIAN DIA.= $D_{N.1}$... <56 µm
$D_{N.5}$... <56 µm
$D_{N.9}$... 76.74 µm

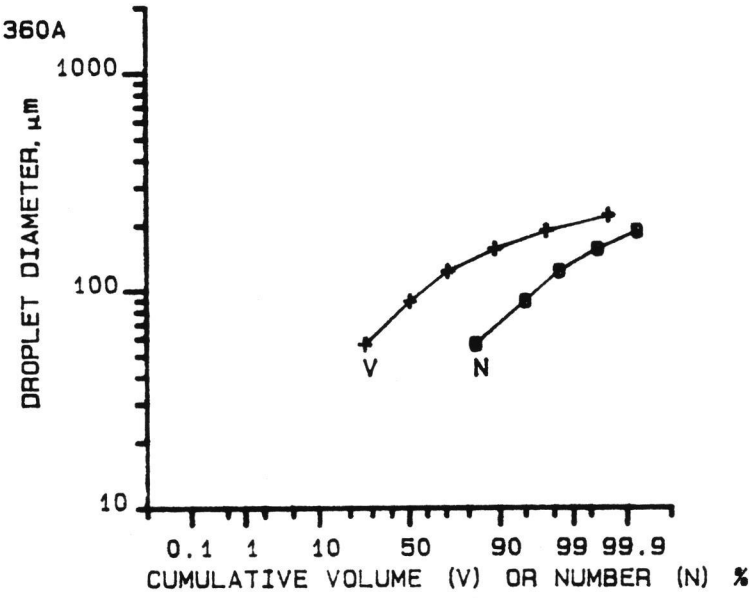
VOLUME MEDIAN DIA.= $D_{V.1}$... <56 µm
$D_{V.5}$... 88.74 µm
$D_{V.9}$... 160.52 µm

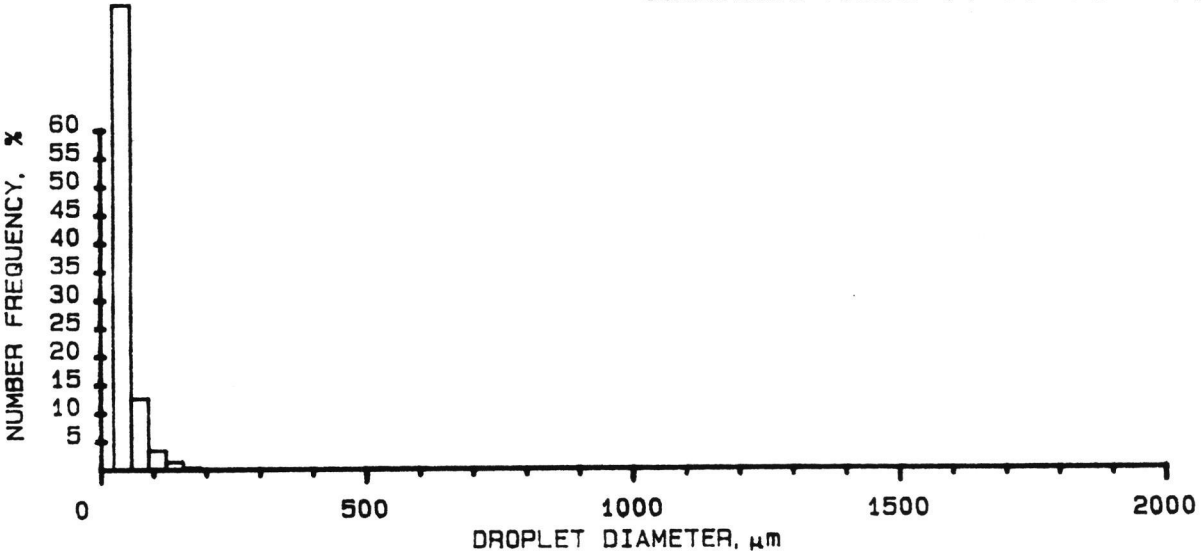
RELATIVE SPAN= 1.42 Extrapolated

Figure VI

Nozzle Type . . . BEECOMIST 360A
RPM 12700
Spray Pressure . . 30 psi
Airspeed . . . . . 50 mph
Flow Rate . . . . .47 gpm
Tank Mix: THURICIDE 48LV, NEAT

FILE: C: \PMS\DATA\08288511.003





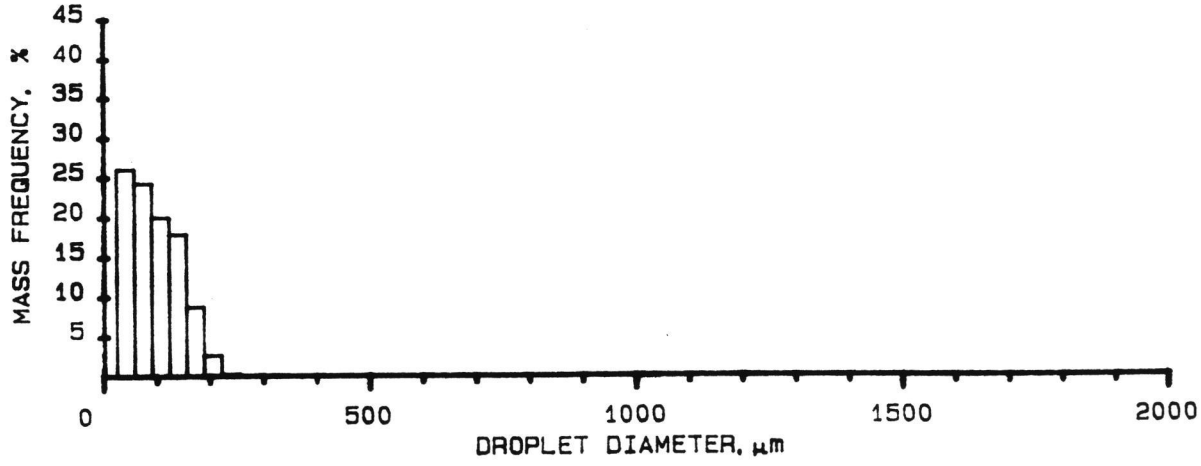


Table XI - Drop Size Data, Beecomist 360A, 50 mph, .95 gpm, 1 Part Thuricide 48LV, 1 Part Water

Nozzle	BEECOMIST 360A	Slice Rate	1.5 MHz
RPM	12700	AVG	20000
Spray Pressure	25 psi	DFM	1 cm.
Airspeed	50 mph	BAR	1.5
Flow Rate	.95 gpm	Distance to Probe	25 cm.
Tank Mix	50% THURICIDE 48LV	Sample Interval	60 sec.
	50% WATER	Number of Samples	1
FILE: C:\PMS\DATA\10108509.003		Number of Sample Rings	9

Number of Tests Combined:2

UPPER LIMIT	N(RAW)	N/SEC	Gm/SEC	% N	% VOL.	ACCUMULATED % N	ACCUMULATED % VOL.
56	14920	2.95E+08	9.72	72.49	15.31	72.49	15.31
89	16882	7.07E+07	14.07	17.36	22.15	89.84	37.46
122	17328	2.87E+07	17.45	7.05	27.47	96.89	64.94
154	15222	9.56E+06	13.08	2.35	20.61	99.24	85.54
187	10155	2.53E+06	6.54	0.62	10.30	99.86	95.85
220	3555	528836	2.31	0.13	3.64	99.99	99.49
252	350	45466	0.31	0.01	0.49	100.00	99.98
284	7	1196	0.01	0.00	0.02	100.00	100.00
318	1	136	0.00	0.00	0.00	100.00	100.00
TOTAL	7.84E+04	4.08E+08	63.49				

TOTAL ACCEPTED RAW PARTICLES / TOTAL IMAGES = 78420/ 108546 = 72.2%

NUMBER MEAN DIA.= D_{10}.... 53.39 µm
VOLUME MEAN DIA.= D_{30}.... 66.78 µm
SAUTER MEAN DIA.= D_{32}.... 84.58 µm

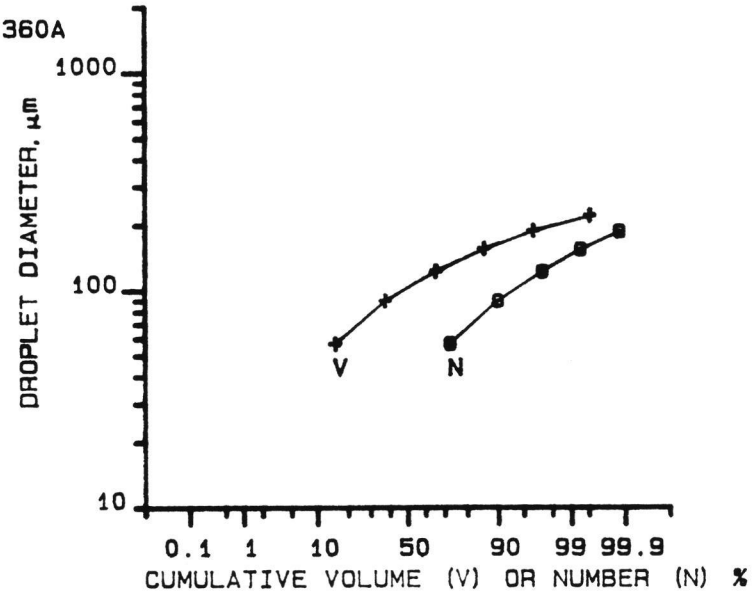
NUMBER MEDIAN DIA.= $D_{N.1}$... <56 µm
$D_{N.5}$... <56 µm
$D_{N.9}$... 89.67 µm

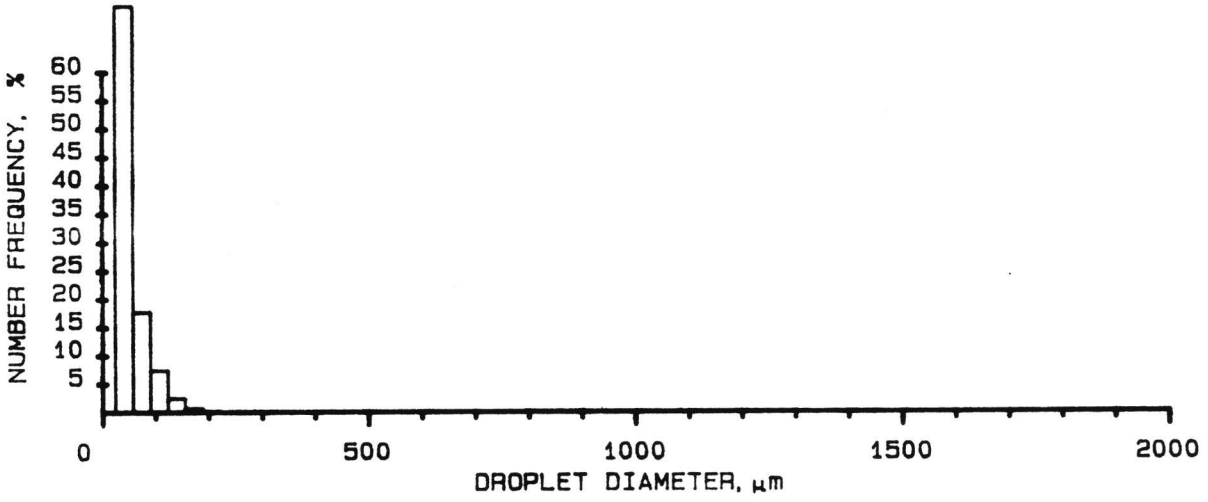
VOLUME MEDIAN DIA.= $D_{V.1}$... <56 µm
$D_{V.5}$... 104.00 µm
$D_{V.9}$... 168.57 µm

RELATIVE SPAN= 1.16 Extrapolated

Figure VII

Nozzle Type . . . BEECOMIST 360A
RPM 12700
Spray Pressure . . 25 psi
Airspeed . . . . . 50 mph
Flow Rate . . . . . .95 gpm
Tank Mix: 50% THURICIDE 48LV
50% WATER
FILE: C: \PMS\DATA\10108509.003





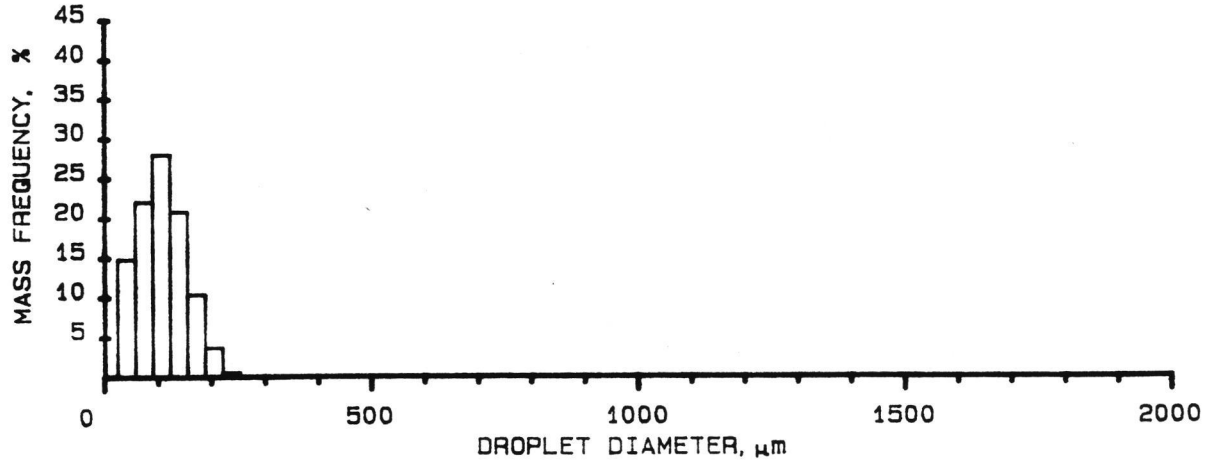


Table XII - Drop Size Data, Micronair AU5000, 135 mph, .95 gpm, Dipel 8L Neat

Nozzle	AU5000	Slice Rate	4 MHz
RPM	7600	AVG	20000
Spray Pressure	40 psi	DFM	1 cm.
Airspeed	135 mph	BAR	1.5
Flow Rate	.95 gpm	Distance to Probe	46 cm.
Tank Mix	DIPEL 8L,NEAT	Sample Interval	60 sec.
		Number of Samples	1
FILE: C:\PMS\DATA\09248509.003		Number of Sample Rings	9

Number of Tests Combined:2

UPPER LIMIT	N(RAW)	N/SEC	Gm/SEC	% N	% VOL.	ACCUMULATED % N	ACCUMULATED % VOL.
56	9560	6.27E+07	2.06	54.02	5.60	54.02	5.60
89	25347	2.41E+07	4.80	20.78	13.02	74.80	18.63
122	24148	1.78E+07	10.81	15.34	29.36	90.14	47.99
154	16362	9.12E+06	12.49	7.86	33.91	98.00	81.90
187	5089	2.06E+06	5.33	1.78	14.48	99.77	96.38
220	747	238287	1.04	0.21	2.83	99.98	99.21
252	58	18843	0.13	0.02	0.35	100.00	99.56
284	8	3146	0.03	0.00	0.09	100.00	99.64
318	2	878	0.01	0.00	0.03	100.00	99.68
351	0	0	0.00	0.00	0.00	100.00	99.68
382	0	0	0.00	0.00	0.00	100.00	99.68
414	1	210	0.01	0.00	0.02	100.00	99.69
447	1	179	0.01	0.00	0.02	100.00	99.72
479	0	0	0.00	0.00	0.00	100.00	99.72
512	0	0	0.00	0.00	0.00	100.00	99.72
545	1	1363	0.10	0.00	0.28	100.00	100.00
TOTAL	8.13E+04	1.16E+08	36.82				

TOTAL ACCEPTED RAW PARTICLES / TOTAL IMAGES = 81324/ 101173 = 80.4%

NUMBER MEAN DIA.= D_{10}.... 66.99 µm
VOLUME MEAN DIA.= D_{30}.... 84.65 µm
SAUTER MEAN DIA.= D_{32}.... 105.53 µm

NUMBER MEDIAN DIA.= $D_{N.1}$... <56 µm
$D_{N.5}$... <56 µm
$D_{N.9}$... 121.64 µm

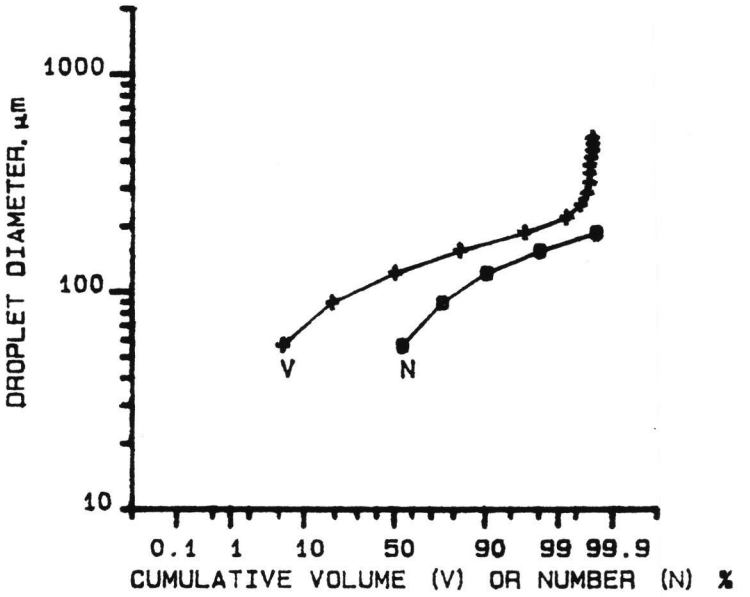
VOLUME MEDIAN DIA.= $D_{V.1}$... 67.41 µm
$D_{V.5}$... 123.56 µm
$D_{V.9}$... 172.77 µm

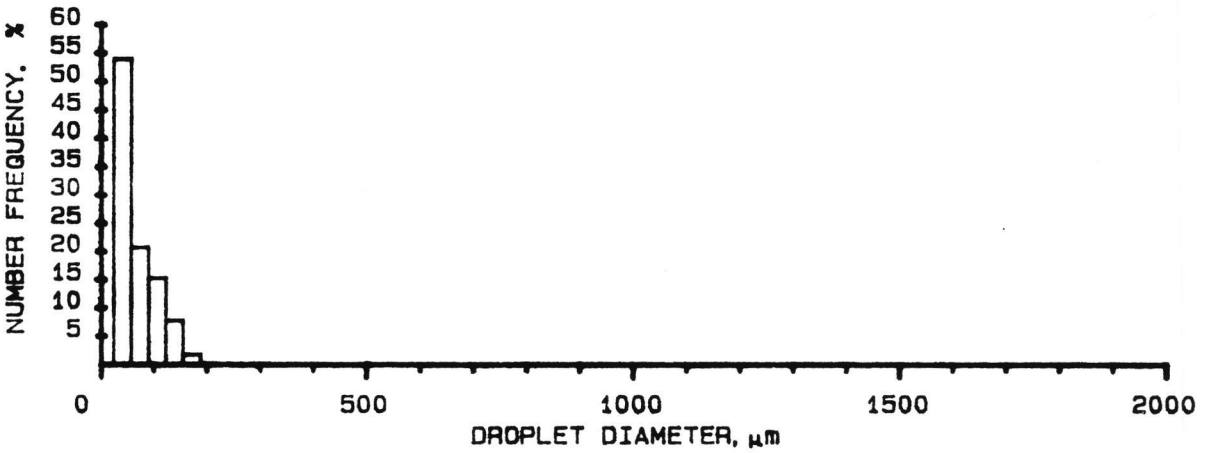
RELATIVE SPAN= 0.85

Figure VIII

Nozzle Type . . . AU5000
RPM 7600
Spray Pressure . . 40 psi
Airspeed . . . . . 135 mph
Flow Rate . . . . .95 gpm
Tank Mix: DIPEL 8L, NEAT

FILE: C: \PMS\DATA\09248509.003





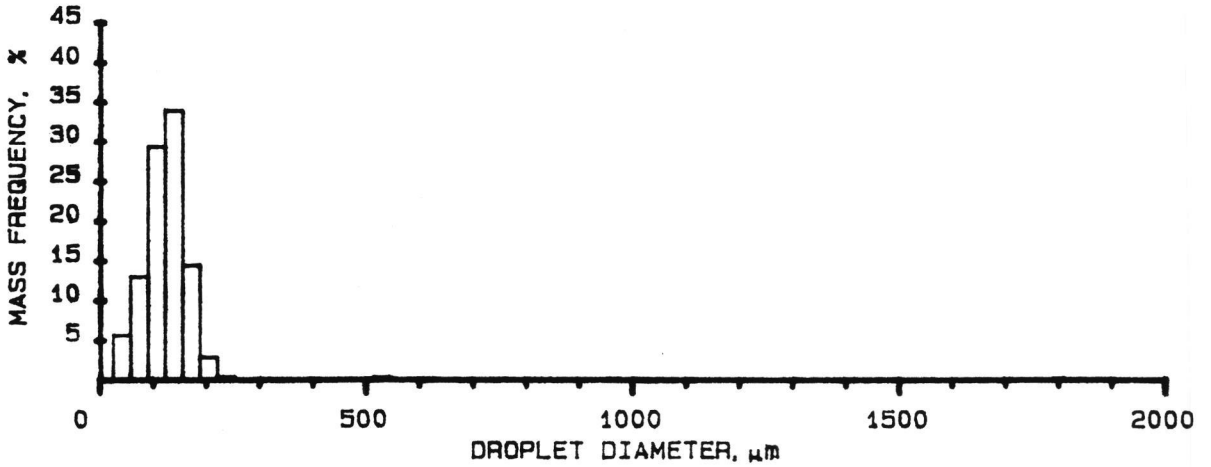


Table XIII - Drop Size Data, Micronair AU5000, 135 mph, 1.9 gpm, 1 Part Dipel 8L, 1 Part Water

Nozzle	AU5000	Slice Rate	4 MHz
RPM	7600	AVG	20000
Spray Pressure	45 psi	DFM	1 cm.
Airspeed	135 mph	BAR	1.5
Flow Rate	1.9 gpm	Distance to Probe	46 cm.
Tank Mix	50% DIPEL 8L,50% WATER	Sample Interval	60 sec.
		Number of Samples	1
FILE: C:\PMS\DATA\08308511.003		Number of Sample Rings	9

Number of Tests Combined:2

UPPER LIMIT	N(RAW)	N/SEC	Gm/SEC	% N	% VOL.	ACCUMULATED % N	ACCUMULATED % VOL.
56	9331	1.34E+08	4.40	57.04	5.85	57.04	5.85
89	20368	4.49E+07	8.92	19.13	11.86	76.17	17.72
122	20816	3.17E+07	19.26	13.52	25.61	89.69	43.33
154	17122	1.82E+07	24.97	7.78	33.21	97.47	76.54
187	6310	5.00E+06	12.95	2.13	17.22	99.60	93.75
220	1196	766895	3.36	0.33	4.46	99.93	98.22
252	222	133914	0.91	0.06	1.21	99.98	99.43
284	50	28407	0.29	0.01	0.38	100.00	99.81
318	10	5630	0.08	0.00	0.11	100.00	99.92
351	5	3079	0.06	0.00	0.08	100.00	100.00
382	0	0	0.00	0.00	0.00	100.00	100.00
414	2	90	0.00	0.00	0.00	100.00	100.00
TOTAL	7.54E+04	2.35E+08	75.19				

TOTAL ACCEPTED RAW PARTICLES / TOTAL IMAGES = 75432/ 104882 = 71.9%

NUMBER MEAN DIA.= D_{10}.... 65.95 µm
VOLUME MEAN DIA.= D_{30}.... 84.95 µm
SAUTER MEAN DIA.= D_{32}.... 108.01 µm

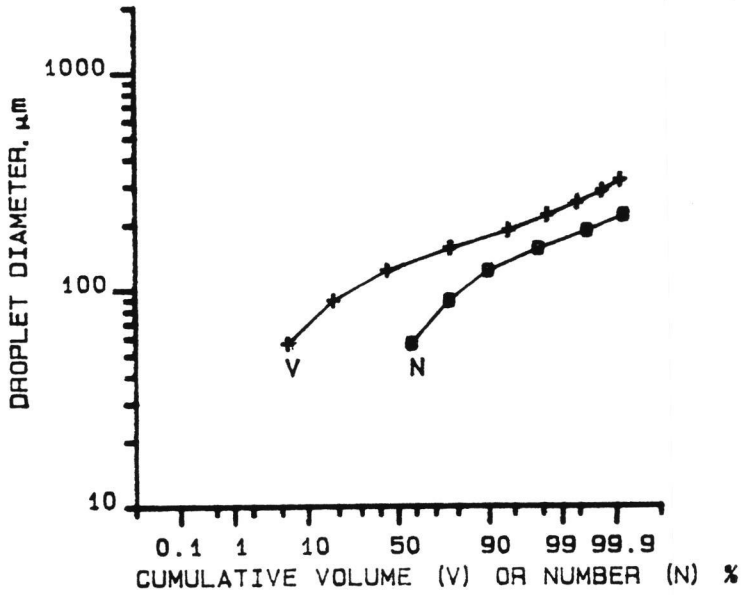
NUMBER MEDIAN DIA.= $D_{N.1}$... <56 µm
$D_{N.5}$... <56 µm
$D_{N.9}$... 122.93 µm

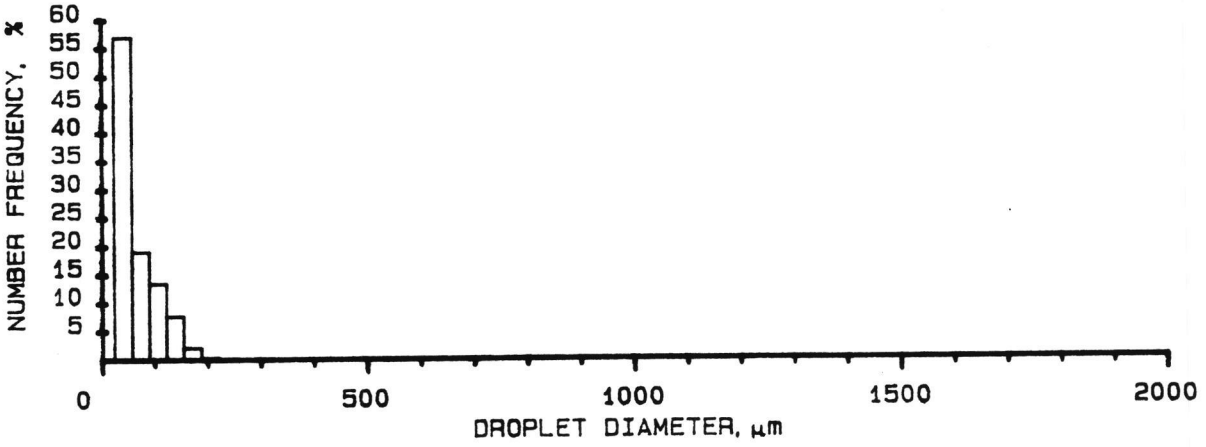
VOLUME MEDIAN DIA.= $D_{V.1}$... 67.81 µm
$D_{V.5}$... 128.23 µm
$D_{V.9}$... 180.11 µm

RELATIVE SPAN= 0.88

Figure IX

Nozzle Type . . . AU5000
RPM 7600
Spray Pressure . . 45 psi
Airspeed . . . . . 135 mph
Flow Rate . . . . 1.9 gpm
Tank Mix: 50% DIPEL 8L, 50% WATER
FILE: C: \PMS\DATA\08308511.003





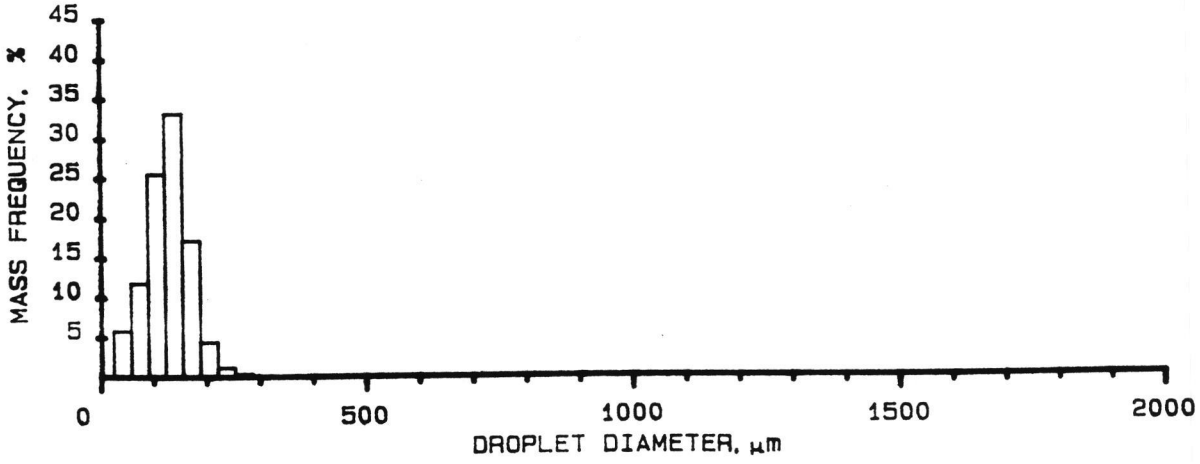


Table XIV - Drop Size Data, Micronair AU5000, 135 mph, 2.6 gpm, 1 Part Dipel 8L, 1 Part Water

Nozzle	AU5000	Slice Rate	4 MHz
RPM	12700	AVG	20000
Spray Pressure	40 psi	DFM	1 cm.
Airspeed	135 mph	BAR	1.5
Flow Rate	2.6 gpm	Distance to Probe	46 cm.
Tank Mix	50% DIPEL 8L,50% WATER	Sample Interval	60 sec.
		Number of Samples	1
FILE: C:\PMS\DATA\09038514.003		Number of Sample Rings	9

Number of Tests Combined:2

UPPER LIMIT	N(RAW)	N/SEC	Gm/SEC	% N	% VOL.	ACCUMULATED % N	ACCUMULATED % VOL.
56	7016	1.55E+08	5.09	62.50	8.25	62.50	8.25
89	18697	4.69E+07	9.32	18.93	15.11	81.43	23.36
122	20114	2.84E+07	17.25	11.48	27.98	92.91	51.34
154	14566	1.39E+07	18.98	5.60	30.79	98.51	82.13
187	4298	3.06E+06	7.93	1.24	12.86	99.75	94.98
220	761	493841	2.16	0.20	3.50	99.95	98.49
252	179	106208	0.72	0.04	1.17	99.99	99.66
284	47	16567	0.17	0.01	0.27	100.00	99.93
318	7	1902	0.03	0.00	0.04	100.00	99.97
351	1	433	0.01	0.00	0.01	100.00	99.99
382	1	283	0.01	0.00	0.01	100.00	100.00
TOTAL	6.57E+04	2.48E+08	61.66				

TOTAL ACCEPTED RAW PARTICLES / TOTAL IMAGES = 65687/ 96112 = 68.3%

NUMBER MEAN DIA.= D_{10}.... 60.99 µm
VOLUME MEAN DIA.= D_{30}.... 78.10 µm
SAUTER MEAN DIA.= D_{32}.... 99.54 µm

NUMBER MEDIAN DIA.= $D_{N.1}$... <56 µm
$D_{N.5}$... <56 µm
$D_{N.9}$... 113.58 µm

VOLUME MEDIAN DIA.= $D_{V.1}$... 60.08 µm
$D_{V.5}$... 120.36 µm
$D_{V.9}$... 174.51 µm

RELATIVE SPAN= 0.95

Figure X

Nozzle Type . . . AU5000
RPM 12700
Spray Pressure . . 40 psi
Airspeed . . . . . 135 mph
Flow Rate . . . . 2.6 gpm
Tank Mix: 50% DIPEL 8L, 50% WATER
FILE: C: \PMS\DATA\09038514.003